FLEXIBLE WAREHOUSE AUTOMATION:

The future of fulfillment

GreyOrange

The future of fulfillment

SUCCESS IN THE E-COMMERCE AGE hinges on being able to automate and execute fulfillment in a flexible manner. With more single-line orders and many more "each" picks to process, as well as tight delivery windows to hit and a challenging labor market, further automation stands out as the only way to meet customer demands while controlling costs.

However, automation needs to be flexible to respond to changes in customer demand, channel or market strategies, or simply to keep up with the pace of change forced by rapid business growth.

> "Many companies are scared to undertake heavy investment in automation because of continuous change in consumer demands, in product mix, in their distribution model, or in the rate of business expansion. They know that if they invest in rigid systems, and those systems aren't easily adaptable, the company won't get the return on investment it expects."

The fundamental problem in automating is that traditional systems that are bolted down to the distribution center (DC) floor can take many months to install and get into operation—and multiple years to see payback on. This gulf between the fast-paced pressures of consumerism and the relatively lengthy time-to-benefit of traditional automation is at the crux of the interest in flexible automation. New forms of automation that are mobile are particularly adaptable.

Examples of today's flexible solutions include autonomous mobile robots (AMRs), especially those managed by software platforms that leverage artificial intelligence (AI). To find out more about drivers and attitudes surrounding flexible automation, Peerless Research Group on behalf of GreyOrange, a multinational company that designs, manufactures and deploys advanced robotics systems for flexible automation, surveyed supply chain professionals about automation needs, their operational challenges, and their outlook on using AMRs.

While respondents most commonly categorized themselves as relatively "cautious and practical" adopters of technology, the survey found AMR use is expected to double within two years. Respondents also believe that mobile robotics will benefit multiple workflows, with order picking being the top area of need.

These survey results reflect the reality that many companies are struggling to adapt their fulfilment operations to the demands of e-commerce and omnichannel retailing, explains Apurva Vadera, Head of Product Marketing for GreyOrange.

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"The reason companies are looking for more automation is because of the multiple impacts of consumerism—the picking complexity, the tight delivery timelines, the various delivery options consumers want, and the need to establish new warehouses to be closer to consumers," Vadera says. "However, many companies are scared to undertake heavy investment in automation because of continuous change in consumer demands, in product mix, in their distribution model, or in the rate of business expansion. They know that if they invest in rigid systems, and those systems aren't easily adaptable, the company won't get the return on investment it expects."

The answer to this challenge—how to automate without getting stuck with infrastructure that is hard to change—is flexible automation. But what does flexible automation mean, both to people in industry and in terms of the building blocks of a solution?

This paper will answer these questions via a presentation of survey highlights as well as a close look at key building blocks of flexible, intelligent warehouse automation systems. This paper will also explain the five foundational elements of flexible automation systems i.e. mobile, modular, collaborative, connected, and driven by intelligent software. We will be looking at these characteristics while considering three key elements of warehouse operation: movement, touchpoints, and storage. Enabling these characteristics through AI-driven software is the key to achieving flexibility.

Growing Interest in Flexible Automation Technologies

THERE IS CLEAR INTEREST IN FLEXIBLE AUTOMATION INCLUDING AMRS. While robots have been used in industry for decades, only in recent years have they become more flexible, meaning that they can be easily adapted to different workflows, routes, or transport/pick requirements via easy to use software.

The survey shows clear interest in AMRs, even though only 5.2% of respondents rated their organization as "innovators" or risk-taking adopters of technology (by contrast, 20.7% said they were early adopters, while 34.5% are "early majority" or cautious). In terms of use outlook for AMRs, 10.9% use them today but 25.7% plan to use them within two years.

When asked to rate the importance of mobile robotic systems to their operation now versus within two years, today 5.4% called AMRs "extremely important," but that grows to 12.5% in two years. Furthermore, while less than 2% call AMRs "very important" today, that

"very important" ranking jumps to 14.3% in two years.

As mentioned, the top operational area respondents believe flexible automation can help with is picking, which drew a 61.4% response. Other top areas of need for flexible automation included sorting/shipping (48.3% response) and storage and replenishment (41.4%).

These key functional areas of a warehouse can be labor intensive without significant use of automation. It's widely recognized that order picking is the activity which consumes the most labor in a DC, not so much because of the actual motion of picking items, but because of the walking or "travel" involved.

"Managers are realizing that with flexible robotics systems, the challenges of constant change can be mitigated."

Current and future adoption/upgrade plans for autonomous mobile robots (AMRs) in your warehouse/DC

32%

15%

Plan to use/upgrade/adopt AMRs during next two years

Now use AMRs
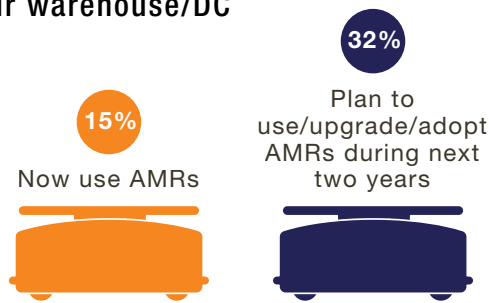
Source: Peerless Research Group

While mobile robots for the warehouse may differ in how they function, most seek to eliminate or minimize labor spent on travel. This pressing need is reflected in the survey, in which respondents rated labor availability at peak times (67.3%) as the top pain point mobile robots can help solve.

Since AMRs with the right software platform are adaptable, they are an ideal automation approach for companies whose fulfillment operations are in flux. In fact, the survey revealed that respondents are concerned that rapid change in factors such as product mix or in channels make it challenging to maintain efficient operations. For example, more than 36% of respondents said change to product mix is either somewhat disruptive or highly disruptive to efficiencies.

Importance of mobile robots to warehouse/DC operations now and in two years

● In two years ● Now

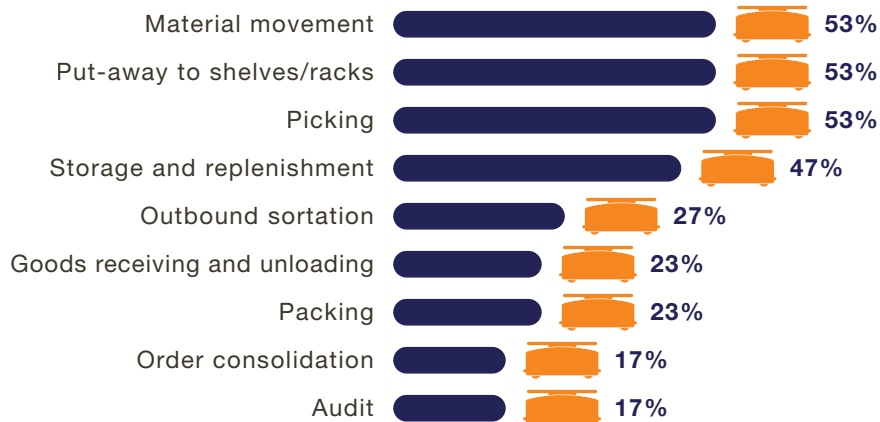|		
		26%
		20%
14%	11%	
6%	3%	
Extremely important	Very important	Somewhat important
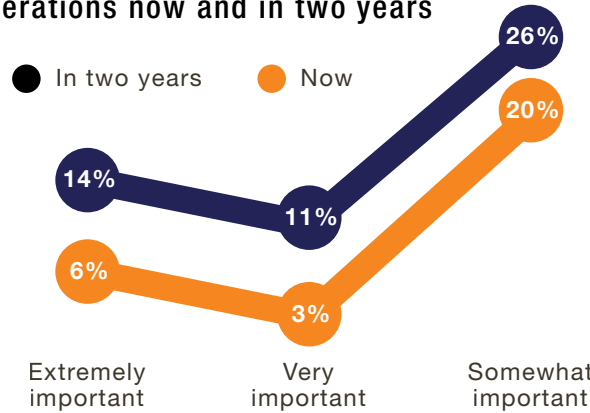
Source: Peerless Research Group

Similarly, more than 20% said that changes to channel mix (e.g., more ecommerce vs. store replenishment) was either highly disruptive or somewhat disruptive.

Interest in AMRs is tied to this call for systems that can easily adapt to changes to product mix, distribution models, or the desire to open new warehouses close to heavily populated areas. "Companies are hesitant to invest in fixed automation because of this constant change," notes Vadera. "Conversely, managers are realizing that with flexible robotics systems, the challenges of constant change can be mitigated."

Applications for which mobile robots are/will be important in warehouse/DC operations

Application	Percentage
Material movement	53%
Put-away to shelves/racks	53%
Picking	53%
Storage and replenishment	47%
Outbound sortation	27%
Goods receiving and unloading	23%
Packing	23%
Order consolidation	17%
Audit	17%

Source: Peerless Research Group

Demystifying the Building Blocks of Flexible Automation

THERE ARE MULTIPLE FACTORS involved in whether automation is flexible or inflexible, but systems that embody mobility, modularity, collaboration, and connectivity, and driven by intelligent software are the systems that are going to be most adaptable to change. Let's break these charactistics down one a time.

Mobile. For optimal flexibility, automation hardware should be mobile rather than fixed or bolted to the floor. Autonomous mobile robots (AMRs) that work as a fluid combination of hardware and software to move goods are highly flexible because they don't have fixed navigation paths, and they can maneuver around obstacles. These fleets of bots can be dynamically allocated across warehouse functions depending on the current workload, which translates to higher asset utilization and lower capex needs. Mobile systems are also easy to move between facilities in minimum time and effort.

> "Thus, it's essential for anyone evaluating AMR solutions to look closely at the capabilities of the software platform. The GreyOrange platform is called GreyMatter. "

Modular. Modular design not only allows systems to scale up or down quickly, but also aids configurability. For instance, a modular storage system of a mobile robotic system holds inventory of various shapes and sizes and it can be reconfigured over time. Modular systems are also highly redundant which means that operations will not be plagued by single point failures. Additionally, modularity runs deeper than hardware, in the sense that the software platform can be easily reconfigured to adapt warehouse workflows.

Collaborative. Warehouse automation systems need to collaboratively work with other systems and resources including humans in a safe and responsive environment. AMRs driven by intelligent software can do this because the software

is constantly coordinating all units as a unified resource to process the fulfillment requirements at hand. Think of a colony of ants, with hundreds of ants simultaneously executing specific tasks but working in unison to achieve the colony's overall goals.

Intelligent software similarly optimizes the assignments of each robot while keeping higher goals like robot fleet utilization and order delivery commitments in mind. Also, new robotic innovations enabled by advances in machine vision, sensing and machine learning have allowed them to work collaboratively with humans even in intricate tasks like picking and packing. Collaboratively designed systems will transform warehouses into more efficient, safer and friendlier places to work.

Connected. A truly connected system is able to exchange and process a huge stream of data in real time, as well as synchronize the movement of all resources with optimized precision. For example, connected robots know exactly where to bring inventory to; they are aware of the most popular items and are able to optimize storage

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locations accordingly. For example, deep storage solutions can "talk" to the robotics system to dynamically retrieve goods to replenish the robotics solution; autonomous piece picking robots can connect and synchronize with goods-to-person mobile robotics; and outbound mobile sortation can communicate with transportation management solutions.

Driven by Intelligent Software. This is perhaps the foundational element, in that it supports the achievement of the four preceding characteristics. An intelligent software platform makes automation flexible because it uses real time decision science techniques to dynamically control factors like resource allocation, task assignment and material movement rather than relying on static rules. AI and machine learning algorithms within the software platform make it possible for the system to learn from operational data on an ongoing basis to become a self-learning engine working to continually improve business metrics. For example, a warehouse will be able to forecast seasonal inventory and order patterns and execute optimum storage strategy for the specific period.

In summary, look closely at whether any automation solution can fully deliver on these five characteristics. Systems that fully embody these characteristics are the ones which will deliver the flexibility you need.

> "People often think of robotic solutions as a hardware play, but it's actually a software play… It is the intelligence layer within the software platform that is constantly optimizing your resources as the system in a continuous feedback loop."

Software as Flexibility Foundation
Mobile robots for the warehouse have a natural flexibility in that they are not fixed to the floor. The robots help fulfill orders by managing a wide variety of inventory, and automatically move specific stock keeping units (SKUs) where they need to go, typically to light-enabled pick/put stations. This creates a flexible "goods-to-person" paradigm that eliminates human travel creating a much more efficient, safe and friendly workspace.

While mobile robotic solutions may seem like a sophisticated hardware system, the differentiator and true source of flexibility in the solution comes from the power of software platform. The technical foundation of the platform consists of AI-based algorithms, based on real -time decision science. This decision science can be thought of a central tenet of Flexible Automation.

It's the ability of AI-driven software to coordinate and optimize resources as conditions and requirement change that is most important to flexibility, explains Subhayu (Sid) Chatterjee, VP of Products. "People often think of robotic solutions as a hardware play, but it's actually a software play," he says. "It is the intelligence layer within the software platform that is constantly optimizing your resources as the system in a continuous feedback loop. A flexible software platform also facilitates easy configurability of work flows and plug-in of new apps for expanded functionalities."

With an intelligent software platform governing moves, routes and material flow for automation solution, the system can make optimal decisions around three key factors: movement, touchpoints, and storage.

For example, movement—deciding which mobile robots should move which storage units—is a real-time optimization exercise that must take into account factors like the shortest routes to pick/put stations, charging needs for the mobile units and availability for specific bots, as well as the best move/pick sequences to fulfill orders on time. Flexibility in movement is thus very much software-driven.

Similarly, managing storage benefits from AI-driven software that is constantly assessing where to best place storage units, when and how to replenish them, or how to rearrange mobile units to account for seasonality. In effect, storage flexibility is software driven. It is flexible because the AI engine is making adjustments to fine tune storage to demand trends and the real-time capacity of the system.

Intelligent software also governs all touchpoints in the system—including handoff to specific pick/put stations, or how the flow of outbound containers synchronizes with downstream activities like packing and shipping.

Five hallmarks of flexible automation in a warehouse
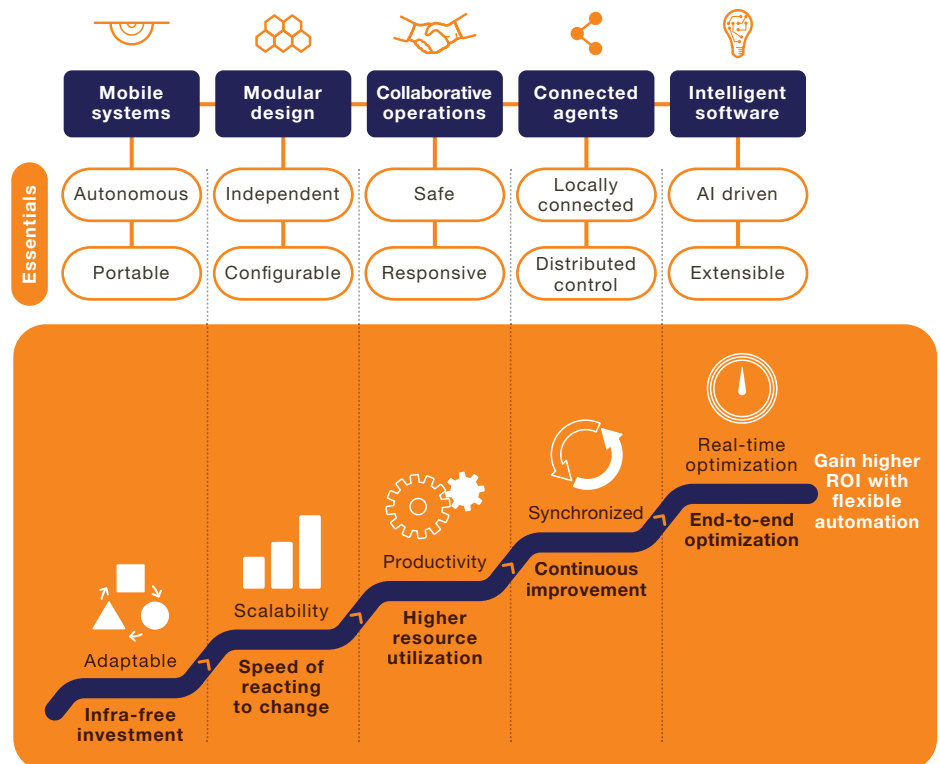
A "Future-Ready Warehouse"... NOW!

WITH THE BUILDING BLOCKS and key characteristics of flexible automation in place, companies can maintain efficiencies and hit throughput goals even in the face of rapid change. As the survey revealed, distribution organizations and supply chain professionals are seeking solutions that make them more productive. However, they are also concerned about the ability to maintain efficiencies even when factors like product mix, channel strategies, or business expansion shift rapidly.

"Establishing fundamental capabilities for flexibility—namely mobility, modularity collaboration, connectivity, and intelligent software—provides the ability to adapt to change."

Any well-designed automation system—if factors like product mix and channel strategy do not change—usually deliver ROI over a given period of time. However, very few companies today can count on factors like channel strategies, or the number and range of SKUs that need to be handled, to stay constant over multiple years. The beauty of flexible automation is that it can adapt to change.

If suddenly your warehouse needs to adapt from handling full pallets or layered pallets to rapidly fulfilling orders in eaches to support e-commerce, flexible solutions such as mobile robotics powered by intelligent software can adapt new workflows quickly.

If your peak seasons vary by regions and DCs serving regions, and you want to move automation assets from one DC to another, you can load up mobile robots and storage units, and move them to the DC that needs the extra capacity.

Or, if the e-commerce strategy involves opening a series of warehouses close to urban consumer centers, mobile robotics can be deployed in days rather than extended months it might take with fixed automation solutions. Perhaps most importantly, AI-driven software has the intelligence to dynamically optimize factors like replenishment, material movement, placement of mobile storage units, labor resources assignments for put/pick stations, or sortation on a real-time basis to flex your automation to demand.

In conclusion, establishing fundamental capabilities for flexibility—namely mobility, modularity collaboration, connectivity, and intelligent software—provides the ability to adapt to change. Flexible warehouse automation is the future because it can adapt to the future in way that gives your business an edge.

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Flexible Automation Enabling Omni-Channel Order Fulfillment

WAREHOUSE AUTOMATION is attractive to companies concerned about finding the right solution to handle the tasks involved with e-commerce/OmniChannel fulfillment. A closer look at how one of GreyOrange's mobile robotics systems are used to handle variable inventory, large SKU counts and bring significant throughput benefits, even in the face of rapid OmniChannel growth:

"A flexible mobile robotics solution not only minimizes labor availability challenges, but it allows to hit throughput goals, handle large SKU counts, and get orders out the door accurately & on-time."

GreyOrange's Butler, a flexible autonomous mobile robotics system, delivered a combination of productivity improvement and attainment of throughput requirements for a large home improvement retail chain in Latin America. The retail chain with distribution operations across six countries deployed Butler at a 450,000 Sq m fulfillment center in Chile. With the growth in e-commerce, the retailer has seen a proliferation in SKUs and needed a flexible solution that can intelligently adapt to their changing business needs and enable them to scale up while delivering accurate-orders on-time at lower operational costs. Partnership with GreyOrange allowed them to manage put away and picking for 20,000 SKUs handled as eaches, cases and pallet, with order fulfillment for both physical stores and eCommerce.

With Butler, the customer was able to fulfill 50% more orders and deliver higher productivity (3x to 5x) gain at lower operational expenses. They were able to adapt to new omnichannel processes, dynamically optimize warehouse operations in real-time, and also leverage a multi-floor storage and retrieval workflow, leveraging a lift arrangement for the mobile robotics.

Fulfill **50%** more orders and deliver

3x to **5x** **higher** productivity at **lower** operational expenses

ABOUT GREYORANGE

GreyOrange is a multinational technology company that designs, manufactures and deploys advanced robotics systems for automation in warehouses, distribution and fulfillment centers. Through the use of flexible automation, the power of AI and exceptional customer service, we work closely with businesses to recognize their needs, optimize the supply chain and enhance process efficiency.

As we prepare businesses for the future, our customers can focus on what they do best: create, sell and innovate. We help our customers evolve their business, without sacrificing what makes it unique. Founded in 2011, GreyOrange is headquartered in Singapore with offices in India, Japan, Germany and USA, and three state-of-the-art research and development centers in USA, Singapore and India.

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